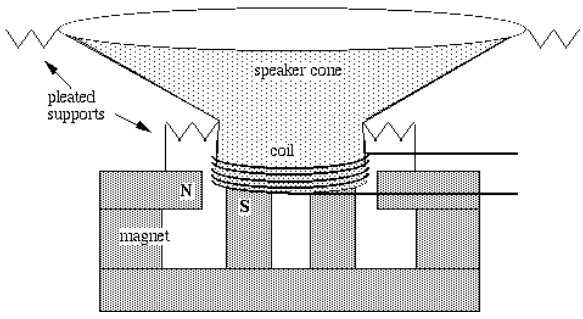
Loudspeakers

A loudspeaker is a linear motor with a small range. It has a single moving coil that is permanently but flexibly wired to the voltage source, so there are no brushes.

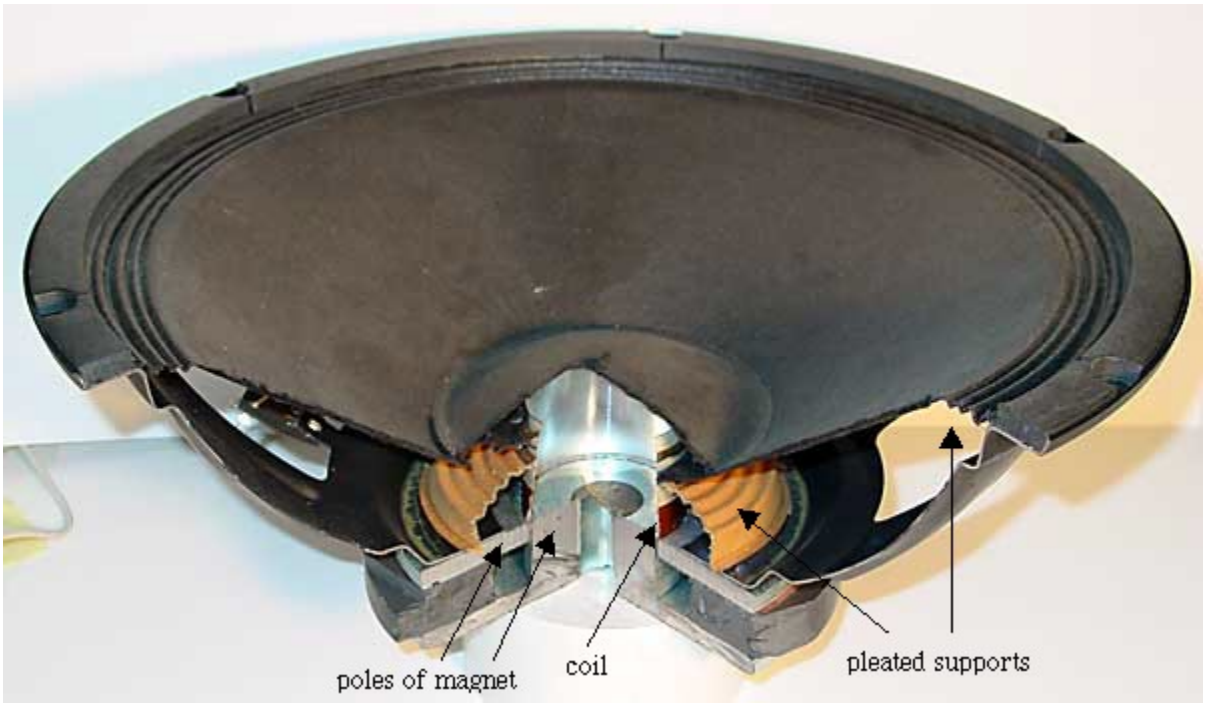
The coil moves in the field of a permanent magnet, which is usually shaped to produce maximum force on the coil. The moving coil has no core, so its mass is small and it may be accelerated quickly, allowing for high frequency motion. In a loudspeaker, the coil is attached to a light weight paper cone, which is supported at the inner and outer edges by circular, pleated paper 'springs'. In the photograph below, the speaker is beyond the normal upward limit of its travel, so the coil is visible above the magnet poles.



For low frequency, large wavelength sound, one needs large cones. The speaker shown below is 380 mm diameter. Speakers designed for low frequencies are called woofers. They have large

mass and are therefore difficult to accelerate rapidly for high frequency sounds. In the photograph below, a section has been cut away to show the internal components.

Tweeters - loudspeakers designed for high frequencies - may be just speakers of similar design, but with small, low mass cones and coils. Alternatively, they may use piezoelectric crystals to move the cone.



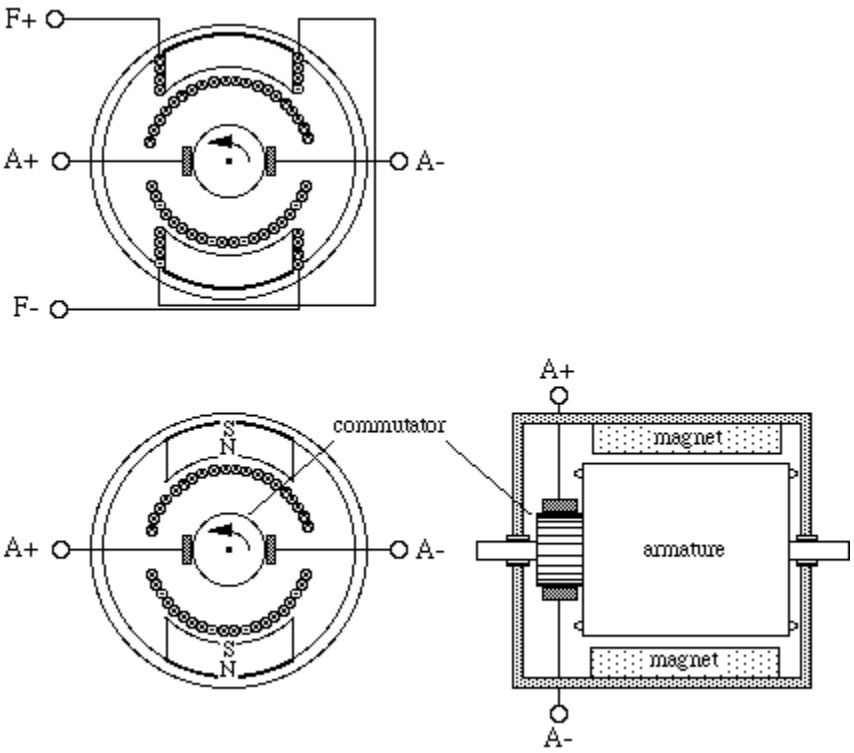
Speakers are seen to be linear motors with a modest range - perhaps tens of mm. Similar linear motors, although of course without the paper cone, are often used to move the reading and writing head radially on a disc drive.

Loudspeakers as microphones

In the picture above, you can see that a cardboard diaphragm (the loudspeaker cone) is connected to a coil of wire in a magnetic field. If a soundwave moves the diaphragm, the coil will move in the field, generating a voltage. This is the principle of a dynamic microphone – though in most microphones, the diaphragm is rather smaller than the cone of a loudspeaker. So, a loudspeaker should work as a microphone. This is a nice project: all you need is a loudspeaker and two wires to connect it to the input of an

oscilloscope or the microphone input of your computer. Two questions: what do you think the mass of the cone and coil will do to the frequency response? What about the wavelength of sounds your use?

Warning: real motors are more complicated



The sketches of motors have been schematics to show the principles. Please don't be angry if, when you pull a motor apart, it looks more complicated! (See How real electric motors work.) For instance, a typical DC motor is likely to have many separately wound coils to produce smoother torque: there is always one coil for which the sine term is close to unity. This is illustrated below for a motor with wound stators (above) and permanent stators (below).

Source: http://www.animations.physics.unsw.edu.au/jw/electricmotors.html